What Is Claimed Is:

1    1.    A method for lightpath restoration in a reconfigurable optical network

2    comprising the steps of:

3    assigning an IP address to each network addressable element in said

4    reconfigurable optical network;

5    determining current topology of said reconfigurable optical network;

6    determining current resources in said reconfigurable optical network;

7    receiving a request to create a restorable lightpath from a source;

8    maintaining information regarding a state of said reconfigurable optical network;

9    selecting first route for data to be transmitted between said source and a

10   destination based on said current resources of said reconfigurable optical network and

11   said current topology of said reconfigurable optical network;

12   selecting at least one alternative route for data to be transmitted between said

13   source and a destination based on said current resources of said reconfigurable optical

14   network and said current topology of said reconfigurable optical network;

15   generating a first API call and corresponding lightpath request message to create

16   a lightpath;

17   generating a second API call and corresponding restoration reservation message

18   to reserve lightpath restoration capacity;

19   forwarding said lightpath request message to each network addressable element

20   along said selected first route;

21   forwarding said restoration reservation message to each network addressable

22   element along said at least one alternative route;

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23         selecting an output channel at each node to be used as an input channel at a next

24       node for use on said selected first route;

25       reconfiguring an OLXC at an input channel at a current node connected to said

26       output channel at said current node;

27       reserving necessary capacity at each node along said at least one alternative route;

28       receiving a response from said destination that said selected first route is

29       available;

30       receiving a response from each said destination that restoration capacity is

31       reserved for each link of said at least one alternative route; and

32       maintaining a restoration state at nodes traversed by said at least one alternative

33       route.

1       2.      The method according to claim 1, wherein said information regarding said

2       restoration state of said reconfigurable optical network is distributed throughout said

3       reconfigurable optical network.

1       3.      The method according to claim 1, wherein said information regarding said

2       restoration state of said reconfigurable optical network is maintained in a soft-state.

1       4.      The method according to claim 1, further comprising the steps of:

2       updating said current topology of said reconfigurable optical network; and

3       updating said current resources of said reconfigurable optical network.

5.      The method according to claim 4, wherein said current topology comprises:

an address for each node at each end of each link;

a total number of active channels on each link;

a number of allocated channels on each link;

a number of preemptable channels on each link;

a number of reserved restoration channel on each link;

Shared Risk Link Groups throughout the reconfigurable optical network; and

optional physical layer parameters for each link.

6.      The method according to claim 1, wherein a first-hop router selects said at least one alternative route.

7.      The method according to claim 1, wherein said second selecting step further comprises the step of determining said at least one alternative route subject to a capacity that is available on each link in said reconfigurable optical network and further subject to a capacity reserved for restoration lightpaths.

8.      The method according to claim 1, wherein restoration capacity is reserved such that for each given link along said selected first route there is at least one alternative route reserved that is completely link disjoint and Shared Risk Link Group disjoint from said given link along said selected first route.

9.      The method according to claim 1, wherein when restoration resources are altered said determining step is repeated and further restoration capacity is reserved such

3   that for each link along said selected first route there is at least one alternative route that

4   is diverse from every other link within the same Shared Risk Link Group.

1       10.     The method according to claim 1, wherein a single end-to-end alternative

2   route is used to restore from all failures along the selected first route such that the single

3   end-to-end alternative route is completely node and Shared Risk Link Group disjoint

4   from the selected first route.

1       11.     The method according to claim 1, wherein restoration resources may be

2   optimized by repeating said determining step whereby further restoration capacity is

3   reserved, wherein said reserving of further restoration capacity may include releasing a

4   portion of said restoration capacity.

1       12.     The method according to claim 1, wherein reserved restoration

2   requirements for each link are stored locally at each link.

1       13.     The method according to claim 1, wherein a total number of resources

2   reserved for each link is a maximum over that required for all fiber span risk groups,

3   thereby ensuring that restoration is guaranteed for all independent Shared Risk Link

4   Group failures and that capacity is shared across said independent Shared Risk Link

5   Group failures.

1       14.     The method according to claim 1, wherein a total number of resources

2   reserved for a given link for restoration is a maximum over all Shared Risk Link Groups

3   of a sum of the resources required on the given link for a failure of all links within each

4   Shared Risk Link Group.

1    15.   The method according to claim 1, wherein reserved restoration capacity is

2    advertised throughout said reconfigurable optical network.

1    16.   The method according to claim 1, wherein for soft-state bandwidth

2    management, a total restoration capacity reserved on a given link for a failure of a given

3    Shared Risk Link Group within said reconfigurable optical network is a sum over all

4    first-hop routers of a capacity required to support the failure of the given Shared Risk

5    Link Group for all lightpaths managed by each first-hop router.

1    17.   The method according to claim 4, wherein information regarding said

2    current resources of said reconfigurable optical network and information regarding said

3    current topology of said reconfigurable optical network are distributed throughout said

4    reconfigurable optical network.

1    18.   A method for lightpath restoration in a reconfigurable optical network

2    comprising the steps of:

3        assigning an IP address to each network addressable element in said

4    reconfigurable optical network;

5        determining current topology of said reconfigurable optical network;

6        determining current resources in said reconfigurable optical network;

7        receiving a request to create a lightpath from a source;

8        selecting a first route for data to be transmitted between said source and a

9    destination based on said current resources of said reconfigurable optical network and

10   said current topology of said reconfigurable optical network;

11    selecting at least one alternative route for data to be transmitted between said

12    source and a destination based on said current resources of said reconfigurable optical

13    network and said current topology of said reconfigurable network;

14    selecting an output channel at each node to be used as an input channel at a next

15    node for use on said selected first route;

16    reconfiguring an OLXC at an input channel at a current node connected to said

17    output channel at said current node;

18    generating a first API call and a corresponding lightpath request message to create

19    a lightpath;

20    generating a second API call and a corresponding restoration reservation message

21    to reserve lightpath restoration capacity;

22    forwarding said lightpath request message to each network addressable element

23    along said selected first route;

24    forwarding said restoration reservation message to each network addressable

25    element along said at least one alternative route;

26    receiving a response from said destination that said selected first route is

27    available;

28    receiving a response from each said destination that restoration capacity is not

29    available on some link along said at least one alternative route and said restoration

30    capacity cannot be reserved for every link of said at least one alternative route; and

31    releasing resources configured and reserved along a partially created lightpath.

19. The method according to claim 18, wherein a first-hop router selects said at least one alternative route.

20. The method according to claim 18, wherein said second selecting step further comprises the step of determining said at least one alternative route subject to a capacity that is available on each link in said reconfigurable optical network and further subject to a capacity reserved for restoration lightpaths.

21. The method according to claim 18, wherein restoration capacity is reserved such that for each given link along said selected first route there is at least one alternative route reserved that is completely link disjoint and Shared Risk Link Group disjoint from said given link along said selected first route.

22. The method according to claim 18, wherein when restoration resources are altered said determining step is repeated and further restoration capacity is reserved such that for each link along said selected first route there is at least one alternative route that is diverse from every other link within the same Shared Risk Link Group.

23. The method according to claim 18, wherein said reserved restoration resource requirements for each link are stored locally at each node.

24. The method according to claim 18, wherein a total number of resources reserved for each link is a maximum over that required for all fiber span risk groups, thereby ensuring that restoration is guaranteed for all independent Shared Risk Link Group failures and that capacity is shared across said independent Shared Risk Link Group failures.

1    25.    The method according to claim 18, wherein a total number of resources

2    reserved for a given link for restoration is a maximum over all Shared Risk Link Groups

3    of a sum of the resources required on the given link for a failure of all links within each

4    Shared Risk Link Group.

1    26.    The method according to claim 18, wherein restoration capacity is

2    advertised throughout said reconfigurable optical network.

1    27.    A method for lightpath restoration in a reconfigurable optical network

2    comprising the steps of:

3        naming each network addressable element in said reconfigurable optical network;

4        determining current topology in said reconfigurable optical network;

5        determining current resources in said reconfigurable optical network;

6        requesting establishment of a restorable lightpath;

7        requesting reservation of restoration capacity;

8        allocating said lightpath; and

9        reserving said restoration capacity.

1    28.    A system for lightpath restoration in a reconfigurable optical network

2    comprising:

3        means for assigning an IP address to each network addressable element in said

4    reconfigurable optical network;

5        means for determining current topology of said reconfigurable optical network;

6        means for determining current resources in said reconfigurable optical network;

7        means for receiving a request to create a restorable lightpath from a source;

8    means for maintaining information regarding a state of said reconfigurable optical

9    network;

10    means for selecting a first route for data to be transmitted between said source and

11    a destination based on said current resources of said reconfigurable optical network and

12    said current topology of said reconfigurable optical network;

13    means for selecting at least one alternative route for data to be transmitted

14    between said source and a destination based on said current resources of said

15    reconfigurable optical network and said current topology of said reconfigurable optical

16    network;

17    means for generating a first API call and a corresponding lightpath request

18    message to create a lightpath;

19    means for generating a second API call and a corresponding restoration

20    reservation message to reserve lightpath restoration capacity;

21    means for forwarding said lightpath request message to each network addressable

22    element along said selected first route;

23    means for forwarding said restoration reservation message to each network

24    addressable element along said at least one alternative route;

25    means for selecting an output channel at each node to be used as an input channel

26    at a next node for use on said selected first route;

27    means for reconfiguring an OLXC at an input channel at a current node connected

28    to said output channel at said current node;

29    means for reserving necessary capacity for said at least one alternative route;

30      means for receiving a response from said destination that said selected first route

31    is available;

32      means for receiving a response from each said destination that restoration

33    capacity is reserved for each link of said at least one alternative route; and

34      means for maintaining a restoration state at nodes traversed by said at least one

35    alternative route.

1      29.     The system according to claim 28, wherein a first-hop router selects said

2    at least one alternative route.

1      30.     The system according to claim 28, wherein said second means for

2    selecting further comprises means for determining said at least one alternative route

3    subject to a capacity that exists on each link in said reconfigurable optical network and

4    further subject to a capacity reserved for restoration lightpaths.

1      31.     The system according to claim 28, wherein restoration capacity is reserved

2    such that for each given link along said selected first route there is at least one alternative

3    route reserved that is completely link disjoint and Shared Risk Link Group disjoint from

4    said given link along said selected first route.

1      32.     The system according to claim 28, wherein when restoration resources are

2    altered said determining step is repeated and further restoration capacity is reserved such

3    that for each link along said selected first route there is at least one alternative route that

4    is diverse from every other link within the same Shared Risk Link Group.

1   33.   The system according to claim 28, wherein a single end-to-end alternative

2   route is used to restore from all failures along the selected first route such that the single

3   end-to-end alternative route is completely node and Shared Risk Link Group disjoint

4   from the selected first route.

1   34.   The system according to claim 28, wherein restoration resources may be

2   optimized by repeating said determining step whereby further restoration capacity is

3   reserved, wherein said reserving of further restoration capacity may include releasing a

4   portion of said restoration capacity.

1   35.   The system according to claim 28, wherein reserved restoration

2   requirements for each link are stored locally at each link.

1   36.   The system according to claim 28, wherein a total number of resources

2   reserved for each link is a maximum over that required for all fiber span risk groups,

3   thereby ensuring that restoration is guaranteed for all independent Shared Risk Link

4   Group failures and that capacity is shared across said independent Shared Risk Link

5   Group failures.

1   37.   The system according to claim 28, wherein a total number of resources

2   reserved for a given link for restoration is a maximum over all Shared Risk Link Groups

3   of a sum of the resources required on the given link for a failure of all links within each

4   Shared Risk Link Group.

1   38.   The system according to claim 28, wherein reserved restoration capacity is

2   advertised throughout said reconfigurable optical network.

1    39.    The system according to claim 28, wherein said information regarding

2    said restoration state of said reconfigurable optical network is maintained in a soft-state.

1    40.    The system according to claim 28, wherein for soft-state bandwidth

2    management, a total restoration capacity reserved on a given link for a failure of a given

3    Shared Risk Link Group within said reconfigurable optical network is a sum over all

4    first-hop routers of a capacity required to support the failure of the given Shared Risk

5    Link Group for all lightpaths managed by each first-hop router.

1    41.    The system according to claim 28, further comprising:

2        means for updating said current topology of said reconfigurable network; and

3        means for updating said current resources of said reconfigurable optical network.

1    42.    The system according to claim 40, wherein information regarding said

2    current resources of said reconfigurable optical network and information regarding said

3    current topology of said reconfigurable optical network are distributed throughout said

4    reconfigurable optical network.

1    43.    The system according to claim 28, wherein said information regarding

2    said restoration state of said reconfigurable optical network is distributed throughout said

3    reconfigurable optical network.

1    44.    A system for lightpath restoration in a reconfigurable optical network

2    comprising:

3        means for assigning an IP address to each network addressable element in said

4    reconfigurable optical network;

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5        means for determining current topology of said reconfigurable optical network;

6        means for determining current resources in said reconfigurable optical network;

7        means for receiving a request to create a lightpath from a source;

8        means for selecting a first route for data to be transmitted between said source and

9        a destination based on said current resources of said reconfigurable optical network and

10        said current topology of said reconfigurable optical network;

11        means for selecting at least one alternative route for data to be transmitted

12        between said source and a destination based on said current resources of said

13        reconfigurable optical network and said current topology of said reconfigurable network;

14        means for selecting an output channel at each node to be used as an input channel

15        at a next node for use on said selected first route;

16        means for reconfiguring an OLXC at an input channel at a current node connected

17        to said output channel at said current node;

18        means for generating a first API call and a corresponding lightpath request

19        message to create a lightpath;

20        means for generating a second API call and a corresponding restoration

21        reservation message to reserve lightpath restoration capacity;

22        means for forwarding said lightpath request message to each network addressable

23        element along said selected first route;

24        means for forwarding said restoration reservation message to each network

25        addressable element along said at least one alternative route;

26        means for receiving a response from said destination that said selected first route

27        is available;

28    means for receiving a response from each said destination that restoration

29    capacity is not available on some link along said at least one alternative route and said

30    restoration capacity cannot be reserved for every link of said at least one alternative

31    route; and

32    means for releasing resources configured and reserved along a partially created

33    lightpath.

1    45.    The system according to claim 44, wherein a first-hop router selects said

2    at least one alternative route.

1    46.    The system according to claim 44, wherein said second means for

2    selecting further comprises means for determining said at least one alternative route

3    subject to a capacity that is available on each link in said reconfigurable optical network

4    and further subject to a capacity reserved for restoration lightpaths.

1    47.    The system according to claim 44, wherein restoration capacity is reserved

2    such that for each given link along said selected first route there is at least one alternative

3    route reserved that is completely link disjoint and Shared Risk Link Group disjoint from

4    said given link along said selected first route.

1    48.    The system according to claim 44, wherein when restoration resources are

2    altered said means for determining is repeated and further restoration capacity is reserved

3    such that for each link along said selected first route there is at least one alternative route

4    that is diverse from every other link within the same Shared Risk Link Group.

1      49.    The system according to claim 44, wherein said reserved restoration

2      resource requirements for each link are stored locally at each node.

1      50.    The system according to claim 44, wherein a total number of resources

2      reserved for each link is a maximum over that required for all fiber span risk groups,

3      thereby ensuring that restoration is guaranteed for all independent Shared Risk Link

4      Group failures and that capacity is shared across said independent Shared Risk Link

5      Group failures.

1      51.    The system according to claim 44, wherein a total number of resources

2      reserved for a given link for restoration is a maximum over all Shared Risk Link Groups

3      of a sum of the resources required on the given link for a failure of all links within each

4      Shared Risk Link Group.

1      52.    The system according to claim 44, wherein restoration capacity is

2      advertised throughout said reconfigurable optical network.

1      53.    The system according to claim 44, wherein said current topology

2      comprises:

3          an address for each node at each end of each link;

4          a total number of active channels on each link;

5          a number of allocated channels on each link;

6          a number of preemptable channels on each link;

7          a number of reserved restoration channel on each link;

8          Shared Risk Link Groups throughout the reconfigurable optical network; and

9     optional physical layer parameters for each link.

1         54.    A system for lightpath restoration in a reconfigurable optical network

2     comprising:

3         means for naming each network addressable element in said reconfigurable

4     optical network;

5         means for determining current topology in said reconfigurable optical network;

6         means for determining current resources in said reconfigurable optical network;

7         means for requesting establishment of a lightpath;

8         means for requesting reservation of restoration capacity;

9         means for allocating said lightpath; and

10        means for reserving said restoration capacity.

1         55.    A method for lightpath restoration in a reconfigurable optical network

2     comprising the steps of:

3         reserving restoration capacity;

4         detecting transmission failures in said reconfigurable optical network;

5         handling exceptions as a result of transmission failures; and

6         allocating said restoration capacity.

1         56.    The method according to claim 55, wherein the step of reserving

2     restoration capacity further comprises the steps of:

3         assigning an IP address to each network addressable element in said

4     reconfigurable optical network;

5         determining current topology of said reconfigurable optical network;

6          determining current resources in said reconfigurable optical network;

7          receiving a request to create a lightpath from a source;

8          maintaining information regarding a state of said reconfigurable optical network;

9          selecting a first route for data to be transmitted between said source and a

10     destination based on said current resources of said reconfigurable optical network and

11     said current topology of said reconfigurable optical network;

12          selecting at least one alternative route for data to be transmitted between said

13     source and a destination based on said current resources of said reconfigurable optical

14     network and said current topology of said reconfigurable optical network;

15          generating a first API call and corresponding lightpath request message to create a

16     lightpath;

17          generating a second API call and corresponding restoration reservation message

18     to reserve lightpath restoration capacity;

19          forwarding said lightpath request message to each network addressable element

20     along said selected first route;

21          forwarding said restoration reservation message to each network addressable

22     element along said at least one alternative route;

23          selecting an output channel at each node to be used as an input channel at a next

24     node for use on said selected first route;

25          reconfiguring an OLXC at an input channel at a current node connected to said

26     output channel at said current node ;

27          reserving necessary capacity on each link of said at least one alternative route;

28          receiving a response from said destination that said selected route is available;

29      receiving a response from each said destination that restoration capacity is

30      reserved and for each channel on each link of said at least one alternative route;

31      maintaining a restoration state at nodes traversed by said at least one alternative

32      route.

1      57.    The method according to claim 55, wherein the step of detecting

2      transmission failures further comprises the steps of:

3      monitoring by a node of said node's local equipment and equipment of said

4      node's immediately neighboring nodes;

5      detecting changes in topology of said reconfigurable optical network; and

6      generating an alarm.

1      58.    The method according to claim 55, wherein said step of detecting

2      transmission failures further comprises the steps of:

3      using a ping to determine whether transmission failures have occurred; and

4      generating an alarm.

1      59.    The method according to claim 55, wherein said step of detecting

2      transmission failures further comprises the steps of:

3      using an IP mechanism similar to a ping to determine whether transmission

4      failures have occurred; and

5      generating an alarm.

1      60.    The method according to claim 55, further comprising the step of passing

2      said alarm up to an IP layer for handling.

1    61.    The method according to claim 55, wherein said handling step comprises

2    the step of escalating said exception up a chain of control, wherein said chain of control

3    locally goes from a router to an OLXC and said chain of control for said lightpath goes

4    from said router to  downstream router along at least one alternative route.


1    62.    The method according to claim 55, wherein said handling step comprises

2    the step of handling said exception immediately upon discovery of said transmission

3    failure.


1    63.    The method according to claim 55, wherein said allocating step further

2    comprises the steps of:

3        retrieving a pre-calculated restoration route;

4        generating a restoration message along said pre-calculated restoration route to

5    configure OLXCs along said pre-calculated restoration route;

6        forwarding said restoration message to each OLXC along said pre-calculated

7    restoration route; and

8        rerouting transmissions onto said pre-calculated restoration route.


1    64.    The method according to claim 55, further comprising the steps of:

2        releasing said allocated restoration capacity; and

3        re-establishing a previously provisioned lightpath.


1    65.    A system for lightpath restoration in a reconfigurable optical network

2    comprising:

3        means for reserving restoration capacity;


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4    means for detecting a transmission failure in said reconfigurable optical network;

5    means for handling an exception as a result of a transmission failure; and

6    means for allocating said restoration capacity.

1    66.    The system according to claim 64, wherein the means for reserving

2    restoration capacity further comprises:

3    means for assigning an IP address to each network addressable element in said

4    reconfigurable optical network;

5    means for determining current topology of said reconfigurable optical network;

6    means for determining current resources in said reconfigurable optical network;

7    means for receiving a request to create a lightpath from a source;

8    means for maintaining information regarding a state of said reconfigurable optical

9    network;

10    means for selecting a first route for data to be transmitted between said source and

11    a destination based on said current resources of said reconfigurable optical network and

12    said current topology of said reconfigurable optical network;

13    means for selecting at least one alternative route for data to be transmitted

14    between said source and a destination based on said current resources of said

15    reconfigurable optical network and said current topology of said reconfigurable optical

16    network;

17    means for generating a first API call and corresponding lightpath request message

18    to create a lightpath;

19          means for generating a second API call and corresponding restoration reservation

20  message to reserve lightpath restoration capacity;

21          means for forwarding said lightpath request message to each network addressable

22  element along said selected first route;

23          means for forwarding said restoration reservation message to each network

24  addressable element along said at least one alternative route;

25          means for selecting an output channel at each node to be used as an input channel

26  at a next node for use on said selected first route;

27          means for reconfiguring an OLXC at an input channel at a current node connected

28  to said output channel at said current node;

29          means for reserving necessary capacity on each link of said at least one alternative

30  route;

31          means for receiving a response from said destination that said selected route is

32  available;

33          means for receiving a response from each said destination that restoration

34  capacity is reserved for each channel on each link of said at least one alternative route;

35  and

36          means for maintaining a restoration state at nodes traversed by said at least one

37  alternative route.

1          67.    The system according to claim 65, wherein the means for detecting a

2  transmission failure further comprises:

3 means for monitoring by a node of said node's local equipment and equipment of

4 said node's immediately neighboring nodes;

5 means for detecting a change in topology of said reconfigurable optical network;

6 and

7 means for generating an alarm.

1 68. The system according to claim 65, wherein said means of detecting a

2 transmission failure further comprises:

3 means for using a ping to determine whether a transmission failure has occurred;

4 and

5 means for generating an alarm.

1 69. The system according to claim 67, further comprising means for passing

2 said alarm up to an IP layer for said IP layer to handle.

1 70. The system according to claim 65, wherein said means for handling

2 comprises means for handling said exception immediately upon discovery of said

3 transmission failure.

1 71. The system according to claim 65, wherein said means for handling an

2 exception comprises means for escalating said exception up a chain of control, wherein

3 said chain of control locally goes from a router to an OLXC and said chain of control for

4 said lightpath goes from said router to a downstream router.

1 72. The system according to claim 65, wherein said means for allocating

2 further comprises:

3          means for retrieving a pre-calculated restoration route;

4          means for generating a restoration message along said pre-calculated restoration

5    route to configure OLXCs along said pre-calculated restoration route;

6          means for forwarding said restoration message to each OLXC along said pre-

7    calculated restoration route; and

8          means for rerouting transmissions onto said pre-calculated restoration route.


1          73.    The system according to claim 65, further comprising:

2          means for releasing said allocated restoration capacity; and

3          means for re-establishing said previously provisioned lightpath.


1          74.    A system for restoration of IP data traffic at an IP layer comprising:

2          means for redirecting transmissions away from a failed component using a pre-

3    computed alternative path;

4          means for issuing a limited scope alarm notification; and

5          means for optimization of network resources using traditional routing protocols.


1          75.    The system according to claim 74, wherein said means for issuing a

2    limited scope alarm includes means for alerting major upstream traffic contributors about

3    a transmission failure.


1          76.    The system according to claim 74, wherein said means for redirecting is

2    accomplished by sending a transmission to a different immediately neighboring node.

1    77.    The system according to claim 74, wherein said means for redirecting is

2    accomplished by tunneling a transmission away from a node that detected said

3    transmission failure.

1    78.    A method for restoration of IP data traffic at an IP layer comprising the

2    steps of:

3        redirecting a transmission away from a failed component of a node using a pre-

4    computed alternative path;

5        issuing a limited scope alarm notification; and

6        optimization of network resources using traditional routing protocols.

1    79.    The method according to claim 78, wherein said redirecting step is

2    accomplished by sending a transmission to a different immediately neighboring node.

1    80.    The method according to claim 78, wherein said step of issuing a limited

2    scope alarm includes alerting major upstream traffic contributors about said transmission

3    failure.

1    81.    The method according to claim 80, wherein said redirecting step is

2    accomplished by tunneling a transmission away from said node having the failed

3    component and is preceded by the step of detecting said transmission failure.

1    82.    The method according to claim 81, wherein said tunneling a transmission

2    away from said node that detected said transmission failure can be achieved using an

3    optical lightpath.

1     83.    The method according to claim 81, wherein said tunneling a transmission

2    can be achieved by prepending a new header to IP packets for forwarding to alternate

3    intermediate nodes.

1     84.    The method according to claim 81, wherein said tunneling a transmission

2    away from said node that detected said transmission failure can be achieved using layer 2

3    tunneling.

1     85.    A system for restoration of IP data traffic at an IP layer comprising:

2         means for redirecting a transmission away from a failed component of a node

3    using a pre-computed alternative path;

4         means for issuing a limited scope alarm notification; and

5         means for optimization of network resources using traditional routing protocols.

1     86.    The system according to claim 85, wherein said means for redirecting is

2    accomplished by sending a transmission to a different immediately neighboring node.

1     87.    The system according to claim 85, wherein said means for issuing a

2    limited scope alarm includes alerting major upstream traffic contributors about said

3    transmission failure.

1     88.    The system according to claim 87, wherein said means for redirecting is

2    accomplished by tunneling a transmission away from said node having the failed

3    component and is preceded by the step of detecting said transmission failure.

1         89.     The system according to claim 88, wherein said tunneling a transmission

2     away from said node that detected said transmission failure can be achieved using an

3     optical lightpath.

1         90.     The system according to claim 88, wherein said tunneling a transmission

2     can be achieved by prepending a new header to IP packets for forwarding to alternate

3     intermediate nodes.

1         91.     The system according to claim 88, wherein said tunneling a transmission

2     away from said node that detected said transmission failure can be achieved using layer 2

3     tunneling.